

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Energy Storage Systems

New Roles and Possibilities

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Representing NERC
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RELIABILITY | ACCOUNTABILITY



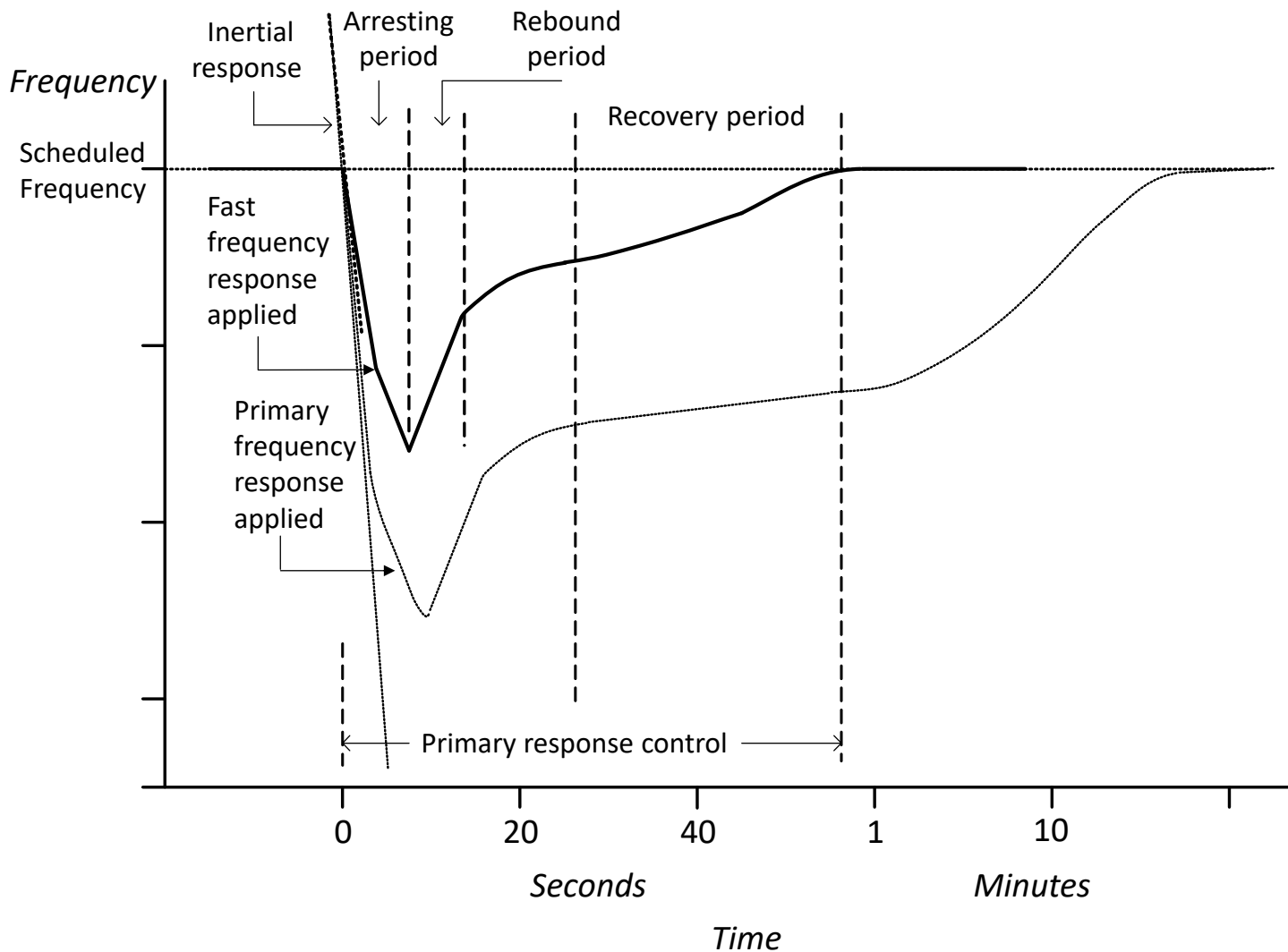
Historically Energy Storage has been in the form of hydroelectric pumped storage (PS)

- Used to store off-peak energy from nuclear & base-load fossil plants
- US has 22,600 MW of existing PS - last plant built in the 1970s

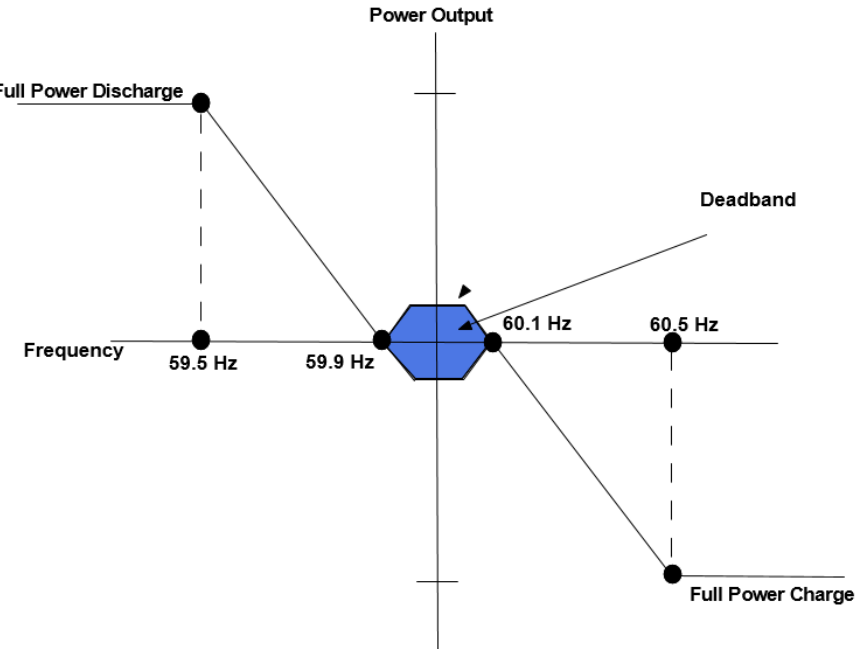
Multiple Roles for Energy Storage in Today's Grid

- Frequency control – continuous proportional response
 - Primary frequency response
 - Fast frequency response – high speed energy injection
- Peak shaving – Temporal energy displacement
- Fast ramping – supplement gen during upward ramps and absorption during downward ramps
- Compensate for variability of solar and wind resources
- Resource for sustained periods of solar or wind unavailability

Frequency Response with FFR Applied

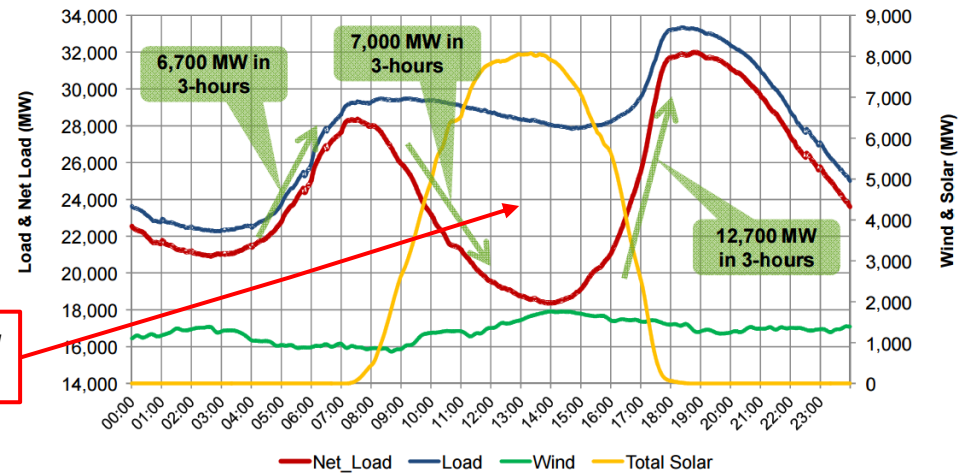


Battery Charging and Discharging



CAISO Load Balancing & Ramping Concerns

Load, Wind & Solar Profiles --- Base Scenario
January 2020



Mid-day Charging Opportunity

- ESS are ***absolutely essential*** to the success of renewable energy goals
- If you like solar and wind, you had better like storage
- ESS have to be able to store energy from the grid as well as co-located renewable sources
- 4-hour battery charges are insufficient to last through the night
 - “If you can’t store more, you’ll have no electricity after 4”
 - Turning off air conditioning in Phoenix in the middle of the night long is not an option.
- We may not be able to make batteries fast enough
- We need to think on a much larger scale for storage such as pumped storage

Aggregation of DER (inc. DR, ESS, EV Chargers, etc.) enhances :

- Blending of dissimilar resources to provide some grid services
 - Ramping services
 - Secondary frequency response
 - Operating reserves
- Grouping of similar device functionality
 - Cohesive EV charging strategies (autonomous addressable devices)



Questions and Answers